

LISTING OF CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

IN THE CLAIMS:

1. (Currently Amended) A process of making crumb and powder rubber comprising:

(a) removing ferrous metal from a stream of granulated used rubber particles;

(b) screening and removing fiber from said stream of granulated used rubber particles;

(c) ~~initially~~ chilling said stream of screened granulated used rubber particles having a predetermined particle size range with a stream of a cryogenic liquid spray and a stream of a cryogenic fluid gas flowing concurrently with said stream of said rubber particles wherein the final chilled temperature of ~~the~~ said rubber particles is controlled with the proviso that said ferrous metal and fiber are removed from said screened particles subsequent to said step (b) but prior to said step (c);

(d) grinding said stream of chilled rubber particles wherein said particle size distribution of said ground rubber particles is controlled; and

(e) screening said ground particle stream into desired crumb and/or powder rubber particle size ranges.

2. (Original) A process in accordance with Claim 1 wherein said used rubber particles are particles of used vehicle tires.

3.-4. (Cancelled).

5. (Previously Presented) A process in accordance with Claim 1 wherein said fiber removing step (b) comprises agitating said rubber particles and aspirating lower density fiber from higher density rubber particles.

6. (Currently Amended) A process in accordance with Claim 1 wherein said ~~control of particle size temperature in step (a) includes control of duration of contact of said rubber particles with said cryogenic fluid~~ stream of said cryogenic gas is generated by contact of said granulated used rubber particles with said cryogenic liquid.

7. (Currently Amended) A process in accordance with Claim 6 wherein said ~~comprising control of controlling said~~ rubber particle size temperature ~~includes by~~ volumetric flow rate control of said ~~spray of said cryogenic fluid liquid contacting said rubber particles.~~

8. (Previously Presented) A process in accordance with Claim 1 wherein said control of particle size distribution in step (d) comprises varying impact surface speed.

9. (Original) A process in accordance with Claim 8 wherein said control of particle size distribution further comprises varying the space between said impact surface and a rebound surface.

10. (Currently Amended) A process in accordance with Claim [[7]] 1 wherein said cryogenic ~~fluid liquid~~ is liquid nitrogen ~~and said cryogenic gas is gaseous nitrogen.~~

11. (Currently Amended) A process in accordance with Claim 1 wherein said stream of ground cryogenically cooled rubber particles ~~after said step (d)~~ are dried to ambient temperature after said step (d).

12. (Currently Amended) A process in accordance with Claim 2 wherein said stream of ground cryogenically cooled rubber particles ~~after said step (d)~~ are dried and fibers present in said ground rubber particle stream are removed after said step (d).

13. (Original) A process in accordance with Claim 12 wherein ferrous metal and fibers in said dried stream of rubber particles are removed.

14. (Original) A process in accordance with Claim 13 wherein said rubber particle stream from which ferrous metal and fiber are removed is screened to remove rubber particles whose particle size exceeds the maximum particle size of crumb rubber and wherein more fiber is removed.

15. (Original) A process in accordance with Claim 14 wherein said particles from which excess sized particles are removed is screened into three rubber particle sizes within the particle size range of crumb and powder rubber.

16. (Currently Amended) A process in accordance with Claim 15 wherein said rubber particles include a first particle size range of particles passing through U.S. sieve size No. 40 but not passing through U.S. sieve size No. 80; a second particle size of particles in the range of between particles passing through U.S. sieve size No. 80 but not passing

through U.S. sieve size No. 140; and a third particle size passing through U.S. sieve size No. 140.

17. (Currently Amended) An apparatus for making crumb and powder rubber comprising:

(a) ferrous metal removal means for removing ferrous metal from a stream of granulated used rubber particles;

(b) fiber removal means for removing fiber from said stream of granulated used rubber particles;

(c) chilling means for initially cooling said stream of granulated used rubber particles having a predetermined particle size range provided with means for introducing said stream of granulated used rubber particles, and a cryogenic liquid spray and a cryogenic gaseous stream ~~fluid~~ whereby said granulated used rubber particles are cooled to a predetermined temperature, wherein said ferrous metal removal means (a) and said fiber removal means (b) are disposed upstream of said chilling means (c);

(d) grinding means for grinding said cooled rubber particles at said predetermined temperature to a predetermined particle size range; and

(e) screening means for separating said ground rubber particles into desired crumb and/or powder rubber particle size ranges.

18. (Original) An apparatus in accordance with Claim 17 wherein said used rubber particles are used vehicle tire particles.

19. (Cancelled).

20. (Previously Presented) An apparatus in accordance with Claim 45 comprising secondary granulation means for granulation of rubber particles that do not pass through said primary screening means; and a preprocessed rubber particle hopper for holding said rubber particles exiting said primary and secondary granulation means.

21. (Original) An apparatus in accordance with Claim 20 comprising a second ferrous metal and fiber removal means for removing ferrous metal and fiber from said preprocessed rubber particles exiting said preprocessed rubber particle hopper.

22. (Original) An apparatus in accordance with Claim 21 comprising a third fiber removal means for removing fiber from said rubber particles exiting said second ferrous metal and fiber removal means.

23. (Currently Amended) An apparatus in accordance with Claim 22 comprising a fiber cyclone and baghouse for storage of said fiber removed by ~~all~~ each of said fiber removal means.

24. (Currently Amended) An apparatus in accordance with Claim 17 comprising an off-specification supersack feeding hopper for introduction of off-specification used rubber particles into a primary screening and fiber removal means wherein said off-specification used rubber particles are screened to remove oversized particles and remove fiber present in said off-specification used rubber particles, said hopper and primary screening and fiber removal means disposed upstream of said ~~component (a)~~ chilling means (c).

25. (Currently Amended) An apparatus in accordance with Claim 17 comprising a preprocessed supersack feeding hopper for introduction of preprocessed used rubber particles preprocessed to screen out particles larger than sizes within the range of crumb and powder rubber and from which ferrous metal and fiber have been removed for ~~removal of ferrous metal~~.

26. (Currently Amended) An apparatus in accordance with Claim 22 comprising a storage bin with metering discharge for storage of said rubber particles exiting said third fiber removal means and from which said granulated used rubber particles are fed into said cooling means (c).

27. (Currently Amended) An apparatus in accordance with Claim 17 wherein said cooling means (c) comprises a cylindrical shaped vessel provided with means for controlled introduction of ~~[[a]]~~ said cryogenic fluid liquid and for time controlled contact of said stream of granulated used rubber particles with said cryogenic fluid liquid.

28. (Currently Amended) An apparatus in accordance with Claim 27 wherein said time controlled contact is provided by a variable speed auger, disposed in said cylindrical shaped vessel, upon which said rubber particles are disposed.

29. (Previously Presented) An apparatus in accordance with Claim 18 wherein said grinding means comprises means for introduction of said cooled granulated rubber particle stream between a controlled speed impact surface and an outer inverted surface.

30. (Previously Presented) An apparatus in accordance with Claim 29 wherein said controlled speed impact surface is an impact surface provided with a plurality of replaceable knives and said outer inverted cone surface has an interior surface, in contact with said cooled granulated stream of rubber particles, comprising a serrated surface.

31. (Currently Amended) An apparatus in accordance with Claim 30 wherein said outer inverted cone surface is movable in a vertical direction wherein volume between said impact surface and said serrated surface of said outer inverted cone surface is increased or decreased.

32. (Original) An apparatus in accordance with Claim 17 including drying means for drying said ground stream of cryogenically cooled rubber particles to ambient temperature.

33. (Original) An apparatus in accordance with Claim 32 wherein said drying means is a rotary dryer provided with a gas entraining stream to separate lower density fiber from higher density rubber particles.

34. (Currently Amended) An apparatus in accordance with Claim 27 wherein said cryogenic ~~fluid liquid~~ is liquid nitrogen, said cryogenic gas is gaseous nitrogen and said cooling means is provided with conduit means for recycle of said ~~vaporized~~ nitrogen gas resulting from ~~seeking contact~~ of said granulated rubber particles with said liquid nitrogen whereby said vaporized nitrogen gas flows concurrently into said cooling means with said granulated rubber particle stream.

35. (Original) An apparatus in accordance with Claim 32 comprising a final ferrous metal and fourth fiber removal means disposed downstream of said drying means for removal of ferrous metal and fiber from said dried rubber particles.

36. (Original) An apparatus in accordance with Claim 35 wherein said final ferrous metal and fourth fiber removal means, disposed downstream of said drying means, comprises a magnetic separator disposed under a vibratory pan screen wherein said ferrous metal is removed below said screen and said fibers are removed above said screen.

37. (Previously Presented) An apparatus in accordance with Claim 36 comprising a fifth fiber removal means, disposed downstream of said final ferrous metal and said fourth fiber removal means, for removal of fiber from said rubber particles exiting said final ferrous metal and fiber removal means.

38. (Original) An apparatus in accordance with Claim 37 wherein said fifth fiber removal means comprises a centrifugal screener wherein light fiber is removed to a fiber cyclone and baghouse.

39. (Original) An apparatus in accordance with Claim 36 comprising a two-deck screening means disposed downstream of said fifth fiber removal means for removal of rubber particles having a size in excess of the size range of crumb and powder rubber.

40. (Original) An apparatus in accordance with Claim 39 wherein said oversized particles are recycled to a storage bin provided with metering discharge, said storage bin being in downstream communication with said cooling means; and said particles passing through said two-deck screening means are conveyed to a three-deck screening means.

41. (Original) An apparatus in accordance with Claim 40 wherein said three-deck screening means comprises a top U.S. sieve size No. 80 screen holding particles passing through a U.S. sieve size No. 40 screen, said particles held on said top screen provided with means for transfer to a U.S. sieve size No. 40 to No. 80 rubber crumb rubber particles storage bin; and a bottom U.S. sieve size No. 140 screen, said particles held on said bottom screen provided with means for transfer to a U.S. sieve size No. 80 to No. 140 storage bin; said particles passing through said bottom screen provided with means for transfer to a powder rubber storage bin holding particles finer than U.S. sieve size No. 140.

42. (Original) An apparatus in accordance with Claim 41 wherein conveyance into said storage bins is effectuated by pneumatic means.

43. (Currently Amended) A process in accordance with Claim 1 wherein said granulated used rubber particles are obtained from an initial charge of used rubber particles which are subjected to the steps of:

(i) removing any tramp metal from said initial charge of used rubber particles;

and

(ii) granulating said product of said step (i)[[:]]

44. (Previously Presented) A process in accordance with Claim 1 wherein said stream of granulated used rubber particles is provided by a charge of preprocessed used rubber particles.

45. (Currently Amended) An apparatus in accordance with Claim 17 comprising:

(i) metal detection and removal means for removing tramp metal from an initial charge of used rubber particles; and

(ii) primary granulation means for granulating said initial charge of used rubber particles;

~~(ii) primary screening and fiber removal means for screening and removing fiber from said granulated initial charge of used rubber metal particles wherein a stream of granulated used rubber particles is formed; and~~

wherein said components (i) and (ii) are disposed upstream of said component (a).